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Design and Fitting of Square Mesh Windows in Whitefish and Prawn Trawls and Seine Nets

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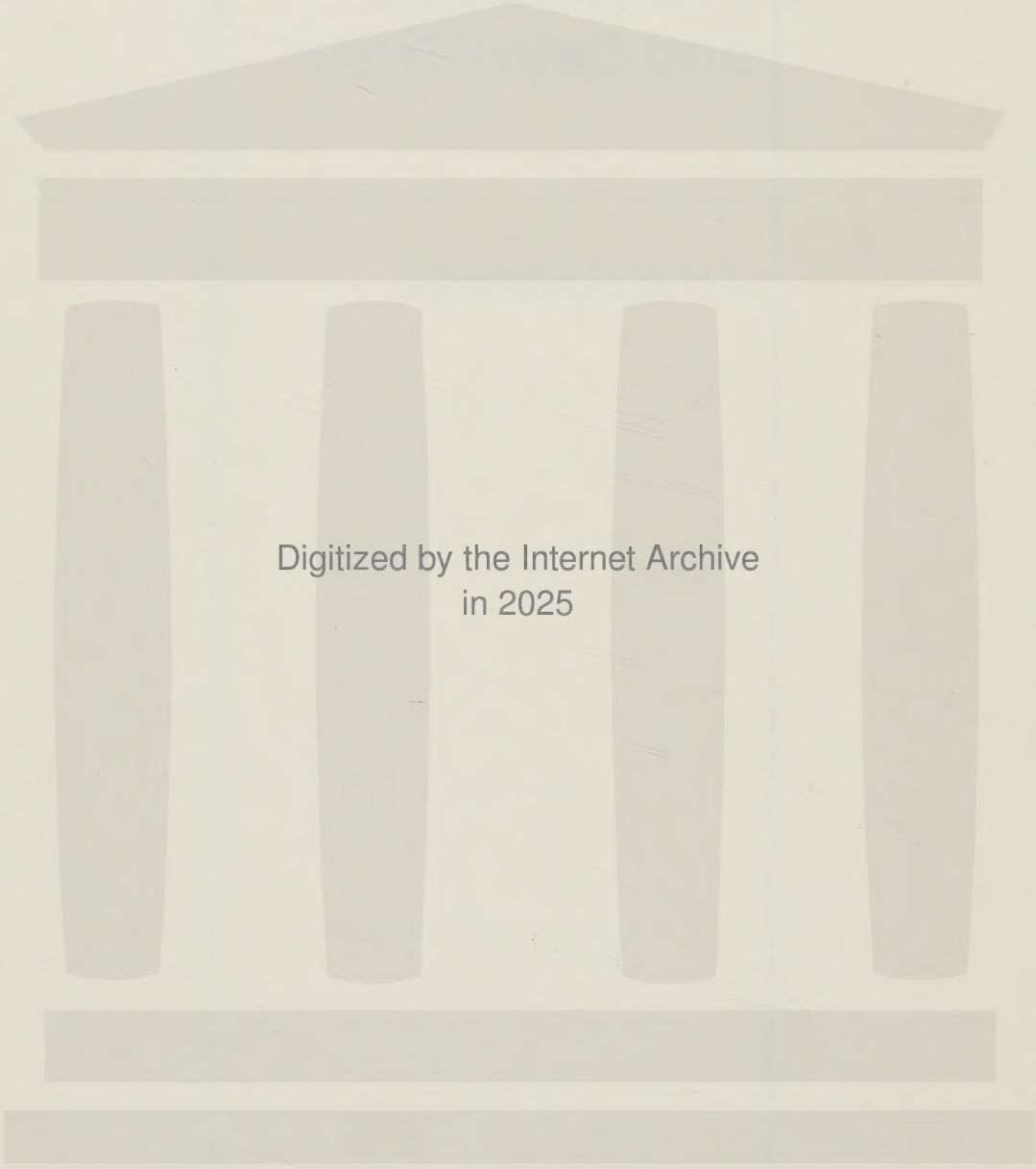

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Design and Fitting of Square Mesh Windows in Whitefish and Prawn Trawls and Seine Nets

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Introduction

Square mesh windows have been developed to improve the escape of juvenile whitefish from the cod-ends of trawls and seines (fly dragging).

Recent studies have shown that large numbers of juvenile fish are caught in seines, whitefish trawls and particularly in prawn trawls, which generally have a smaller minimum mesh size than whitefish trawls. These juvenile fish which are below the minimum landing size are discarded from the vessel's deck. They are called "discards" and are usually dead.

The discards are captured because of the design of the net. The net is constructed of twine forming diamond shaped meshes. These close up under towing tension and reduce the possible escape area. This is why some juveniles cannot escape through the meshes. By opening the meshes, more young fish can escape. One method of opening the meshes is to use square shaped mesh in the trawl construction. Unlike diamond meshes, square meshes stay open under tension.

Some whitefish species, particularly whiting and haddock, have a tendency to push against the top sheet netting of the extension and cod-end (see Fig.1) as they pass back along the trawl during the capture process. Square mesh panels have been placed in this area so that the young fish can more easily penetrate through the netting (see Plate I). More fish are stimulated to escape by exploiting their behaviour in association with more open square meshes. The square mesh panels placed in the top sheet of the cod-end or extension are called "windows".

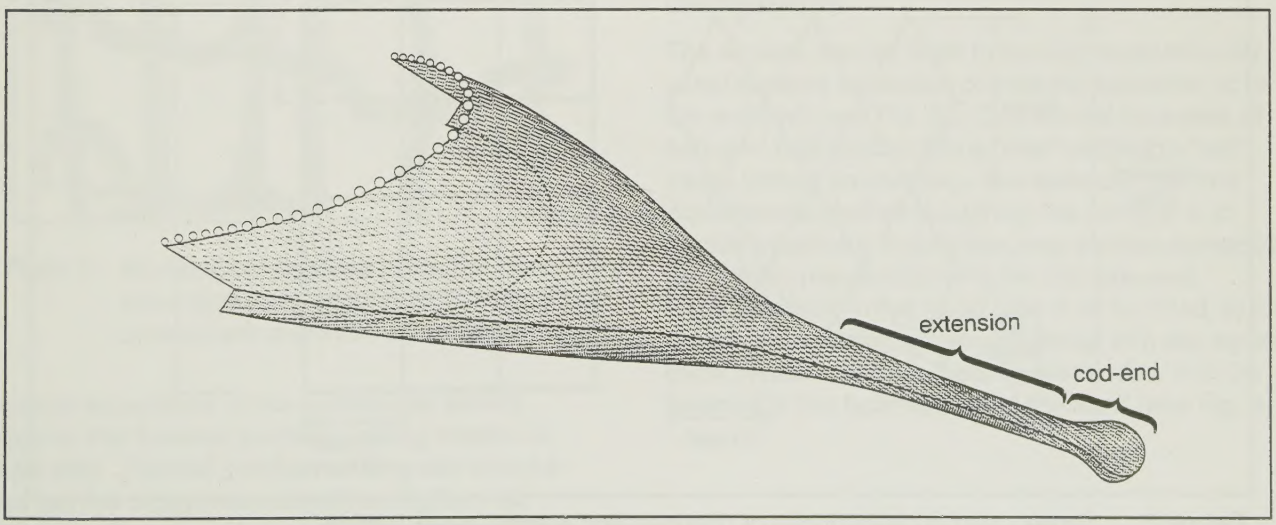

Figure 1. Schematic representation of a trawl net showing areas of the net called "extension" and "cod-end".

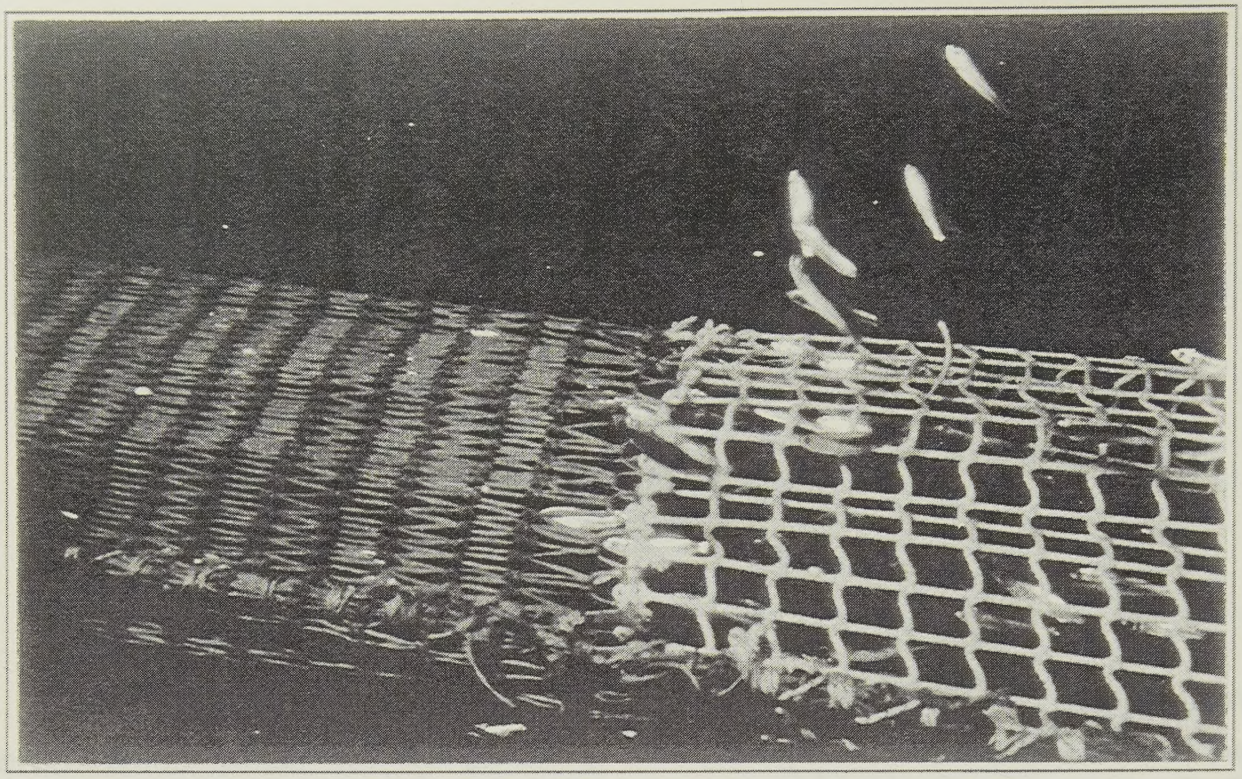

Plate I. Fish escaping through the square meshes.

This pamphlet describes how the windows are constructed and fitted in both whitefish and prawn trawls. Problems regarding the position and operation of the windows and possible solutions are also discussed.

The terms used in the description of diamond and square mesh netting are given in Figure 2.

The construction of square mesh windows may be divided into the following steps: selection of materials; window design and preparation; window fitting; and maintenance.

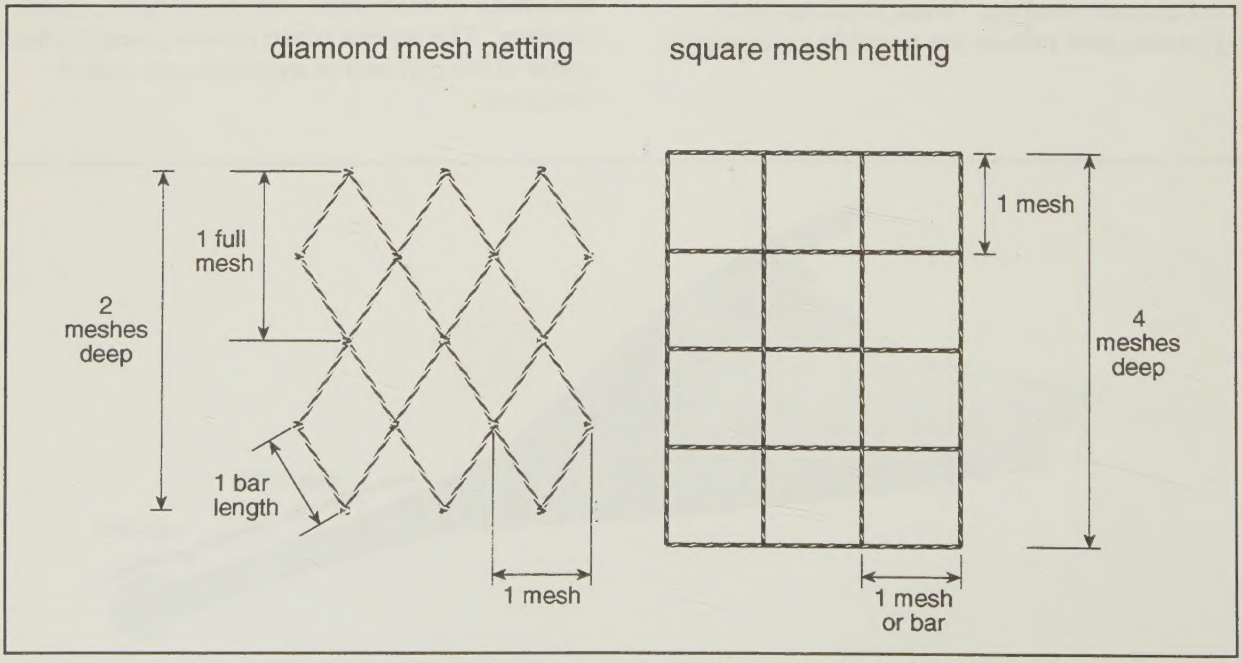

Figure 2. Terms used in descriptions of diamond and square mesh netting.

Selection of Materials

Material type

There are several choices of material: knotted or knotless netting, braided or twisted twine, polyethylene or other material type. It is best to use a material and twine type similar to the surrounding netting because material shrinkage and extensibility will be similar.

In certain circumstances knotless netting tends to be superior to knotted netting. This is because knot slippage can occur with knotted netting used as square mesh. Some manufacturers have improved resistance to knot slippage by heat setting the knots. Knot slippage can also be reduced or eliminated by roping lengthwise along the netting (see Plate II).

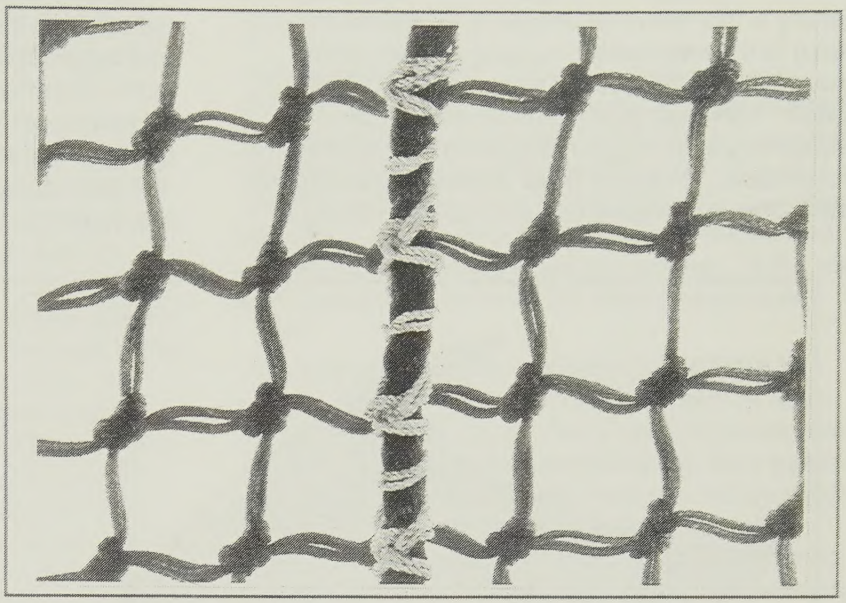

Plate II. Longitudinal roping of knotted square mesh netting to eliminate knot slippage.

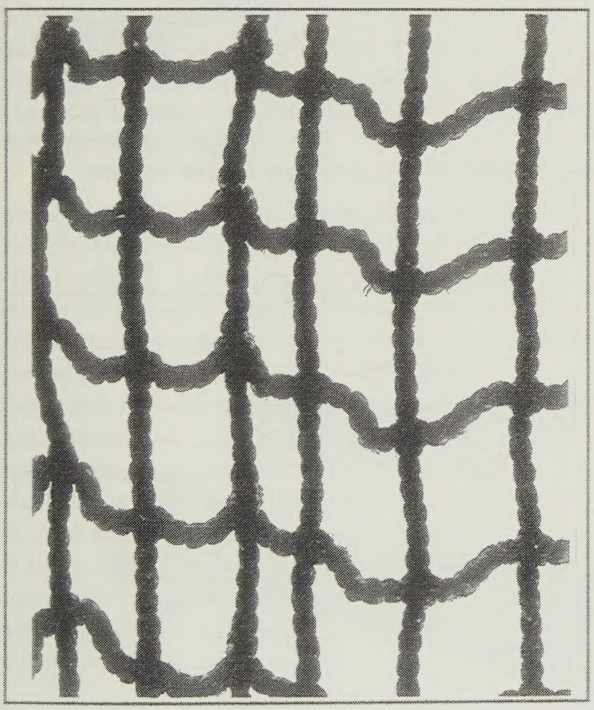

Plate III. With twisted knotless twine the cross bars have tightened causing shortening and a consequent distortion of the square mesh.

Practical experience in the commercial fishery suggests that braided knotless netting retains its shape well. Twisted knotless netting can also be used but the cross-bars sometimes tighten up, shortening the bar and distorting the square mesh (see Plate III).

Strength

On a mesh-for-mesh basis the strength of square mesh is reduced relative to that of diamond mesh. It may be desirable therefore to increase the twine diameter by about 1 mm in the window netting where this is compatible with any regulations on twine size. However, this may only be required if the window is close to the codline where large stresses and strains will transmit to the netting when lifting the catch aboard and where breakages or knot slippage are most likely to occur.

Window Design and Preparation

Configuration

The window can be fitted to the top panel of a two panel tapered extension or straight extension or in the cod-end (see Fig. 3). One should be aware of potential problems in fitting "new" netting to "old" trawls before proceeding. For example, the first consideration before designing the window is to decide whether i) a complete new section comprising the square mesh window in the top side and diamond mesh in the lower side is to be fitted, ii) just the top side netting is to be replaced with the square mesh window, or iii) a rectangular window is to be inserted in the tapered part of the trawl (see Fig. 4).

mesh window, or iii) a rectangular window is to be inserted in the tapered part of the trawl (see Fig. 4). The disadvantage of fitting only the window into old netting is that twine shrinkage or extension may occur in the new netting causing the old netting around the window or the window netting itself to distort. This may give rise to serious blockage problems with the catch lying on the forward side of the window. However, there is a cost advantage in fitting only the window because so little netting is required and preparation and fitting time are minimal.

If the whole tubular section is made up with new square mesh netting in the top sheet and diamond in the lower sheet the cost is higher, but has the advantage that the top and lower sheets will shrink or extend at the same rate if the same netting material is used. There will be no tendency to distort the old netting forward and aft of the new section as would be the case if just the window was fitted.

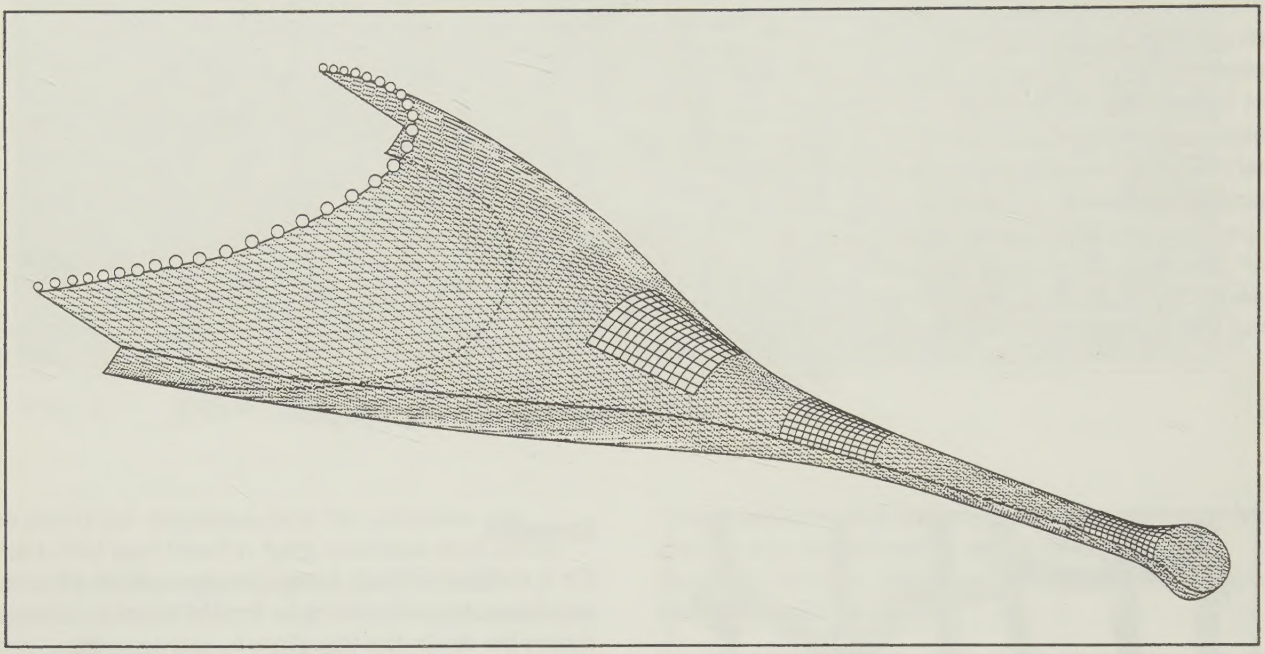

Figure 3. Schematic representation of a trawl net showing three possible positions for the square mesh window.

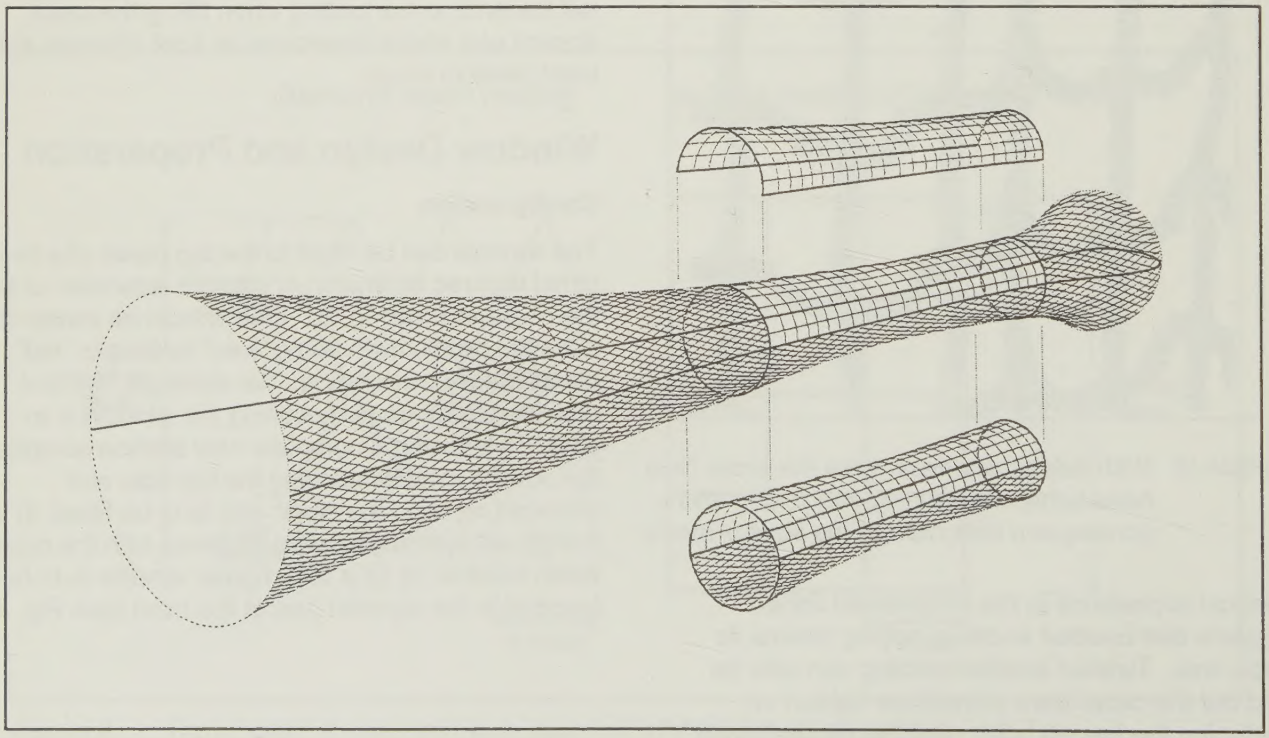

Figure 4. Two methods of inserting a square mesh window.

Position

The fitting of square mesh windows in prawn trawls is a compromise between not losing large fish or prawns and at the same time allowing as many juvenile whitefish as possible to escape. There may be a legal restriction on the position of the square mesh window in the trawl.

Underwater observations have shown that trawl and seine net cod-ends and extensions can twist up. Twists may place the window on the underside of the cod-end where it will not be effective in releasing haddock and whiting. An added danger in prawn trawls is that prawns will escape through the window if it lies on the underside. Therefore, the window will need to be sited forward of any suspected area of twisting. Certain classes of smaller trawls tend to have short cod-ends and straight extensions behind the tapered belly of the trawl, and to avoid possible twists the square mesh window may need to be in the tapered part of the trawl. The window may lie between the selvedges across the full width of the trawl. Alternatively, a rectangular shaped square mesh window may be inserted to lie between, but not touching, the selvedges with a strip of diamond mesh along each selvedge side.

Whilst the cod-end contents are being unloaded onto the vessel some of the fish or prawns in a large catch which have spilled back into the extension may come into the window area and escape. It may be necessary therefore to place the window in a position which minimises such losses.

However, to release as many juvenile fish as possible, the window should be as close as possible to the cod-end. Despite the problems already mentioned it is very important to limit the window position to the narrow extension or cod-end or in the tapered part of the trawl next to the extension. Indeed this may be a legal requirement. Underwater observations have shown that in some circumstances (eg with high headline trawls) windows are less effective in the wider parts of the net. The nearer to the codline the window is sited the more effective it will be in releasing young fish in such trawls. However, in the case of low headline trawls the window can be sited further forward and be equally effective.

Length

The window will need to be a specific number of bars long to fit precisely into the net, allowing of course for a joining row of meshes at the front and rear. UK or EC regulations may specify a minimum length of the window. A length of at least 3 m will ensure an adequate area of open meshes although the longer the window, the more effective it will be. Some small vessels may use nets too small to accommodate a 3 m window and may be allowed therefore to use a shorter window.

Width

The window width is dictated by the number of diamond meshes to which it is joined. For example, to ensure maximum opening of the square meshes, experience has shown that a join of two diamond meshes to one square mesh is best. It is also the easiest to install but does assume the same mesh size in the window and adjacent netting. There may be legal requirements on the joining rates used.

Tapered square mesh windows can be fitted to match into tapered parts of the extension or after belly. If the same mesh size is used in the window as in the netting forward and behind it, then again a two diamond to one square mesh join will generally ensure a distortion-free panel and surrounding netting. Estimating the number of square meshes across the front and rear of the panel becomes more complicated if the mesh sizes are different. One method is to estimate the mesh opening of the diamond meshes to which the window is joined.

Estimation of width

Estimation of the diamond mesh opening depends where the window is to be sited. In general, the nearer the headline of the net the more the diamond meshes will be open. For example, at the start of the tapered extension, between the straight extension and the belly, the diamond mesh opening ratio may be 0.2 to 0.3. The mesh opening ratio aft towards the codline may be 0.1 to 0.2. Note that the mesh opening ratio is the lateral opening of the mesh (between centres of side knots) divided by the mesh size. These ratios have been obtained from underwater observations of a range of different designs of trawl gear. The appropriate mesh opening ratio is multiplied by the mesh size (equation 1 below). This is then multiplied by the number of diamond meshes across the width of netting to which the square mesh window is joined (equation 2 below). It is this measurement which when divided by the bar length (between knot centres) of the square mesh will dictate the number of square meshes across the join (equation 3 below).

$$\textit{Opening of one mesh} = \textit{Opening ratio} \times \textit{diamond mesh size} \qquad (1)$$

$$\textit{Window stretched width} = \textit{Opening ratio} \times \textit{diamond mesh} \times \textit{number of diamond meshes} \qquad (2)$$

$$\textit{Number of square meshes across window} = \frac{\textit{Window stretched width}}{\textit{square mesh bar length}} \qquad (3)$$

Cutting out

Sheet netting is usually produced with the meshes on the "diamond". The square mesh panel is cut out of sheet netting by cutting along a bar (see Fig. 5). One extra mesh should be included around the perimeter. It will be marled back by one bar on to the actual perimeter to give some added strength and to stop the mesh crossover joints from unravelling which can be a particular problem with knotless netting (Plate IV). Heat setting of the twine cuts may help to prevent unravelling but even then it is as well to marl one mesh back on to itself round the perimeter. The marling can be in either single or double twine and should give a neat stiff perimeter (Plate V). Braiding a row of diamond meshes on to the forward and aft edges of the square mesh window will simplify the joining of the window to the net.

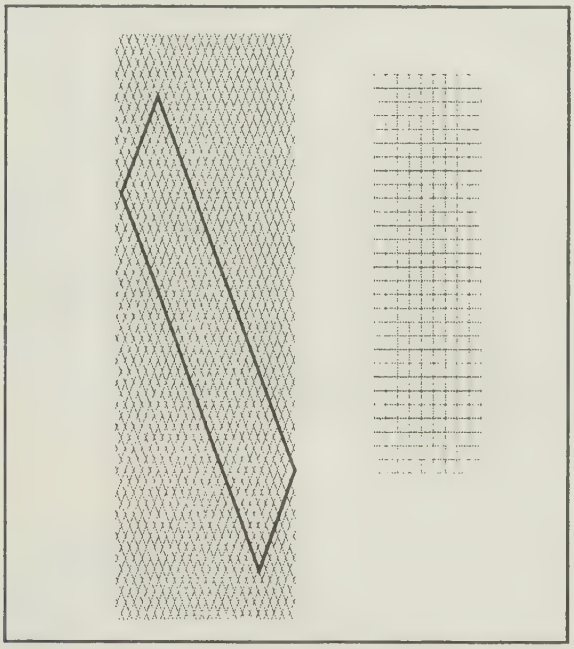

Figure 5. The square mesh panel is cut from diamond sheet netting on the left, then stretched out to give the characteristic shape of panel on the right.

Window Fitting

If a window only is to be fitted then a hole or section into which the window will fit must be cut out of the top panel extension or cod-end.

For insertion of a whole section with both top and lower panels, the net needs to be split and the new window section inserted. This will lengthen the net. To compensate, an equivalent length of the net should be cut out. This method of installation will ensure that the over-all length of net is the same as before.

The square meshes can be joined directly to the diamond meshes. It is best to clove hitch every square mesh bar and apply a weaver's knot to the diamond meshes. It is not good practice to reeve a twine loosely through the meshes on the joining round as this might cause large holes in the joining round through which marketable fish may escape. Every second or third square mesh can be clove hitched with the twine looped through the intervening meshes for quick attachment. Baitings on the diamond meshes also help to close the holes in the joining round.

Before joining the window into the net, check that its length corresponds exactly to the hole cut out of the net, by measuring length-for-length along the

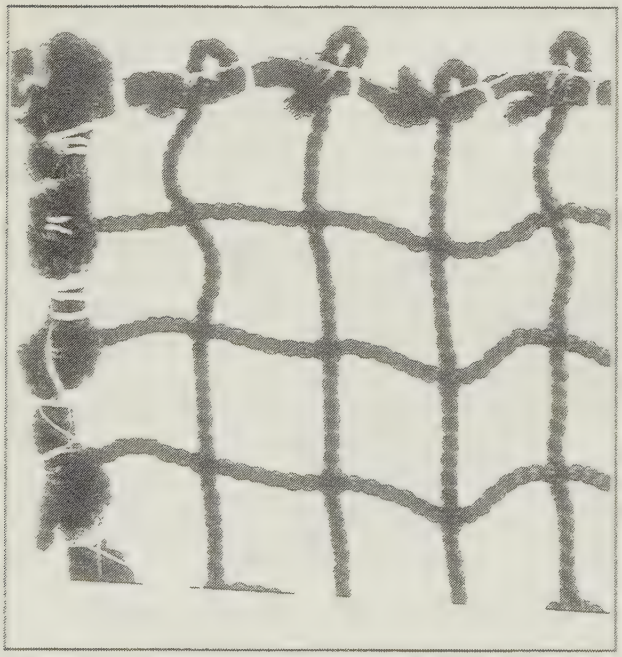

Plate IV. One corner of the square mesh panel showing marling of one full mesh to give added strength.

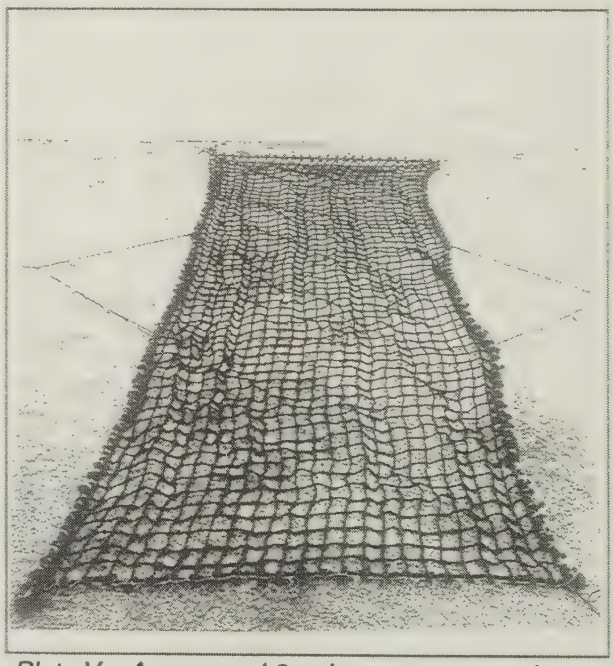

Plate V. A prepared 3 m long square mesh panel constructed with 4mm diameter twisted knotless polyethylene netting.

selvedge. The selvedge and the window edge should be stretched tight for the measurement. With the front and rear joining row in place, the panel should be an exact fit with no loose netting along the selvedge or across the joins.

Maintenance

Knot slippage

Regular inspection for knot slippage is required with knotted netting. Replacement of the window will be necessary with bad knot slippage. Likewise, with twisted knotless netting, if the cross bars tighten up, replacement is necessary because the panel distorts the entire shape of the working section of the net and may seriously affect its catching ability.

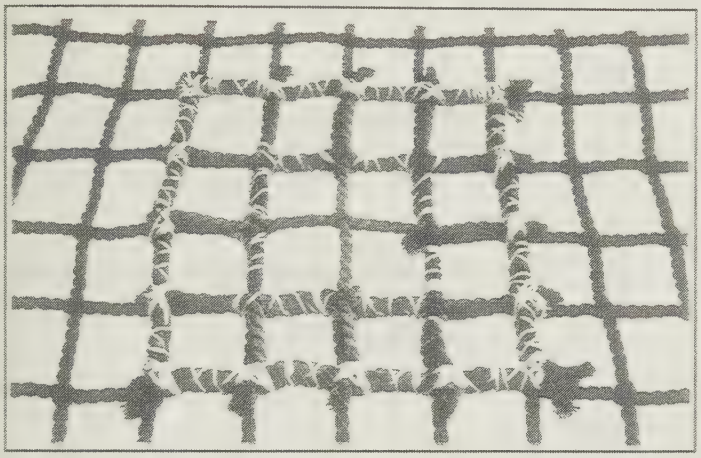

Plate VI. A replacement section in a square mesh panel. The hole is two meshes by two meshes. The repair piece is marled along its perimeter as well as around the edge of the hole.

Fish meshing

Meshing of fish in the square meshes has not been a problem in the Scottish fishery apart from occasional reported meshing of dogfish. If meshing does occur it may affect both the release of young fish and the net shape. Meshed fish should be removed therefore.

Blockages

Fish and prawns lying at the forward end of the window in prawn trawls may indicate serious blockage problems. Although such blocking may occur even without a window, it should be dealt with immediately when a window is in place. It usually means that loose pockets, or a single area of loose netting, have been created by incorrect fitting of the panel. The netting may be too tight or too slack along or across the square mesh panel; the selvedging may be incorrect; or there may be stretching of the meshes in the square mesh panel relative to the lower diamond mesh panel causing distortion in the cross section which may not allow the catch to pass back to the cod-end.

Repairs

Repairs to square mesh netting can be carried out in either of two ways. Clean regular shaped holes (ie square or rectangular or a combination of the two) can be replaced by installing a piece of netting of the same size and shape, and marling round the edge (Plate VI). Alternatively the common method for repairing diamond mesh may be adopted. The square meshes are hauled onto the diamond and the hole repaired in the normal way with a weaver's knot (Plate VII). With knotless netting it is necessary to start the repair one mesh in from the hole to establish the repair twine on solid netting around the hole before moving into the hole area. This is necessary because the joints in knotless netting can unravel causing the perimeter mesh to break apart.

Summary

Commercial fishing gear may retain large numbers of undersized whitefish which are discarded dead at sea. Square mesh windows in the upper panel of a cod-end or extension increase the area of open meshes giving juvenile fish greater chance of escape.

Techniques for designing and installing square mesh windows in trawls and seines are described. Either knotless or knotted netting may be used. The factors affecting the choice of window size and position are discussed. Calculations are given for the length and width of the window to avoid distortion. Methods of cutting out and rigging the window are recommended. Practical suggestions for maintenance and repair are made.

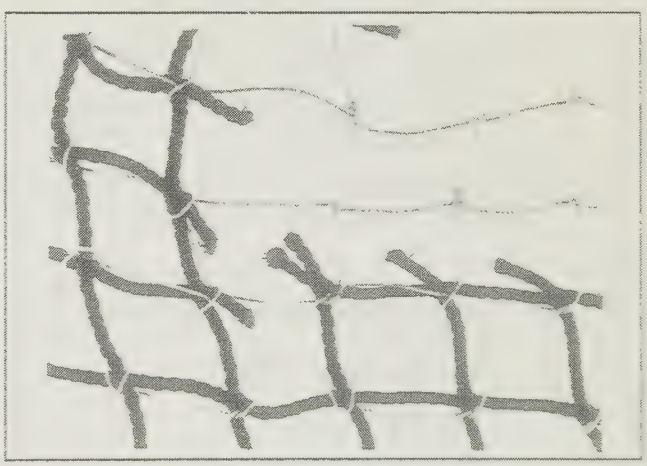

Plate VII. A hole in a square mesh panel is repaired by normal weaver's knotted mending. Note that for illustrative purposes a thinner than normal repair twine has been used.

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